upper part for a distance of eighteen yards thrown into the field. Then came about 9 yards of wall quite undisturbed, and afterwards thirty-six yards half down, but lying in the roadway on the opposite side of the wall. About seventeen yards of the coping-stone at the extreme northern end of the broken wall was also thrown into the road.

Fortunately the whole lay at the time of our visit just as when the whirlwind had passed, and proved conclusively that, in this case at least, the order of rotation was the same as that of the cyclones of the northern hemisphere. THOMAS DOBSON

Marine School, South Shields, June 22

Zoological Geography—Didus and Didunculus

I AM at a loss to understand how *Didunculus* can be called "a near congener" of the Dodo, as Mr. Searles V. Wood, apparently following Dr. Litton Forbes (whose paper I have not seen), terms it (*suprà*, p. 220). The two birds, so far from being congeneric, belong to perfectly distinct groups of the Order *Columbæ*, and nearly thirty years ago Bonaparte treated them as the types of distinct families—*Didida* and *Didunculidæ*—an example which has been generally followed by the best authorities. If Mr. Wood will refer to a paper in the *Philosophical Transactions* for 1869 (pp. 327–362) I think he will see that there is good ground for not attaching much importance to the slight and superficial characters in which *Didunculus* resembles the *Didida*. ALFRED NEWTON

June 30

A Subject-Index to Scientific Periodical Literature

I BEG permission to ventilate in your columns a subject which must make itself felt more or less to all your readers, viz., the want of some subject-index to the vast amount of material scattered about in the numerous scientific periodical publications of the present day. It is true we have the admirable catalogue of the Royal Society, but unless you are acquainted with the name of every author who has written on your subject, it is nearly hopeless attempting a complete bibliography of it. Now I would suggest whether an index to the Royal Society's catalogue cannot be made on the same plan that has been adopted by the committee of the new edition of "Poole's Index," viz., by getting different societies, libraries, or individuals to take certain parts of the work. The following is a short abstract of how this committee have set about their work; any of your readers who wish for further information will find it at pp. 109–206 of the "Transactions and Proceedings of the Conference of Librarians, London, 1878," and on p. 201 a short specimen may be seen. The index is made on sheets of foolscap, and the indexer has nothing to do with alphabetical arrangement; he makes his entries in the order the articles occur in the volume at which he is working; these sheets are then sent to the editors, who cut them into slips and work them into alphabetical order with the material coming in from other sources. By this method complete uniformity is maintained; for should the indexer have a peculiar idea of his own how any particular part should be done, his peculiarity is put right at the central bureau or editorial office.

I have said this should be an index to the Royal Society's catalogue, but if this scheme is ever carried into execution I would strongly urge that the index should be made from the periodicals themselves, and not from the entries in the Royal Society's catalogue, as it is absolutely impossible to index a paper properly from the title only; and another advantage is that under this plan the work could be better carried out, as each indexer could confine himself to his own branch of study; whereas if the index were made from the catalogue itself, it must be cut up into alphabetical portions, and each man would have to do a variety of subjects. This may seem to many too large a matter even for consideration, but for many years so was a good alphabetical catalogue of the different scientific papers; this has been conquered by the Royal Society, and if that learned body would constitute itself the central bureau, I think willing workers would soon be found, and the success of the index be assured. Of course all this would cost money, but surely an appeal might fairly be made to scientific societies and individuals to help in this work, which would be so great a help to the "advancement of science." JAS. B. BAILEY

Oxford

A NEW TRIUMPH OF CHEMICAL SYNTHESIS

THE year 1868 was a marked epoch in the progress of chemical synthesis as well as of tinctorial processes. The German chemists, Profs. Graebe and Liebermann, succeeded at that date in preparing from the hydrocarbon anthracene manufactured from coal tar the brilliant dyestuffs hitherto won from madder, and in establishing also the chemical constitution of these various compounds and their relationship to other well-known bodies. This was the first instance in which the chemist had succeeded in artificially preparing colours occurring in the vegetable kingdom; and although the manufacture of artificial madder colouring matters has assumed at the present day colossal proportions and bids fair to entirely supersede the preparation of the natural products, it has hitherto remained the only instance of the kind in the history of chemistry, all other vegetable and animal dyes obstinately refusing to disclose the secret of their composition and be classified among the compounds of well-defined molecular structure. Within the past few weeks the madder colours have ceased to occupy this unique position. Modern chemistry has succeeded in preparing synthetically none other than common indigo, the well-known product of the *Isatis tinctoria*, and *Nerium tinctorium* of India and South America.

This discovery is likewise due to a German chemist, Prof. A. Baeyer, the genial successor to the chair of Liebig at Munich, one of the most indefatigable and successful investigators of our day. For a score of years he has been seeking to solve the problem of the constitution of indigo and its synthetical preparation. Slowly and patiently he has gathered together and elaborated one fact after another, until finally, at the last session of the German Chemical Society, he was able to announce the completion of the long research and the discovery of the last link in the chain of synthetic reactions leading to the formation of indigo.

We will sketch briefly the various steps in this synthesis, which is not only one of the most brilliant chemical achievements of the present year, but affords an unusually interesting glimpse into the methods and aims of the modern chemist.

Indigo blue, or indigotine, possesses the formula C_8H_5NO, and, from the products of its decomposition, aniline, orthoamidobenzoic acid, &c., has long been regarded as closely allied to the benzene series. Attempts without number have been made to show the nature of this connection by starting from benzene compounds, but hitherto with fruitless results. As in the case of the alizarine compounds, where Graebe and Liebermann first found that anthracene was obtained from alizarine by reducing agents, so has the first step in the solution of the indigo problem been to study carefully the various compounds resulting from successive decompositions, each in turn yielding a body of a simpler constitution. Passing from one compound to another, Prof. Baeyer finally reached alpha-toluic acid or phenylacetic acid, $C_6H_5.CH_2.COOH$, a not uncommon body, easily prepared from cyanide of benzyl. Here he stopped, and began to retrace his footsteps.

The first reaction was to replace one of the hydrogen atoms in the phenylic group of *phenylacetic acid*,

$$\text{(A.)}\quad C_6H_5.CH_2.COOH,$$

by the group NO_2—a familiar operation effected by treatment with nitric acid—and giving, among other compounds, *ortho-nitrophenylacetic acid*,

$$\text{(B.)}\quad C_6H_4\begin{cases}CH_2.COOH\\NO_2\end{cases}.$$

This, when reduced by nascent hydrogen—*i.e.*, submitted to treatment with a mixture of tin and hydrochloric

acid—gives the corresponding *ortho-amidophenylacetic acid*,

$$(C.)\quad C_6H_4\begin{cases}CH_2.COOH\\NH_2\end{cases}.$$

In a neutral solution this acid is changed into its anhydride by the elimination of a molecule of water forming

$$(D.)\quad C_6H_4\begin{cases}CH_2.CO\\NH\end{cases}\rangle.$$

And here we leave the long names indicative of the structural composition of the compounds: for Prof. Baeyer has found that this anhydride is identical with oxindol, one of the derivatives of indigo. The next steps are to introduce the nitroso group, NO, forming *nitroso-oxindol*,

$$(E.)\quad C_6H_4\begin{cases}CH(NO).CO\\NH\end{cases}\rangle,$$

and to reduce this as before to *amido-oxindol*,

$$(F.)\quad C_6H_4\begin{cases}CH(NH_2).CO\\NH\end{cases}\rangle.$$

This compound, when oxidised with chloride of iron or copper, or with nitrous acid, is changed entirely into *isatin*,

$$(G.)\quad C_6H_4\begin{cases}COCO\\NH\end{cases}\rangle,$$

a substance resulting from the oxidation of indigo, which already in 1870 Prof. Baeyer, by the action of phosphorus trichloride, had changed back into *indigo-blue*,

$$(H.)\quad \begin{matrix}N.C_6H_4.CO.CH\\ \|\qquad\quad \|\\ N.C_6H_4.CO.CH\end{matrix},$$

by the union of two molecules and the elimination of two atoms of oxygen. With this last transformation the synthesis was completed. Although the operations are too numerous and too costly to allow at present any hope of the practical utilisation of this ingenious succession of reactions, the series presents still a remarkable example of the possibilities in the hands of the organic chemist, of the powers of combination requisite for the successful pursuit of modern synthetical research, and of the attractions which draw to this province the majority of our leading chemists. T. H. N.

BIOLOGICAL NOTES

THE COMET-FORMS OF STAR-FISHES.—Ernst Haeckel, in a recent number of the *Zeitsch. wiss. Zool.* (1878, Supplement 3), draws attention to these forms, and the support which the facts recently established as to the power possessed by certain star-fishes of multiplying by throwing off their arms, lends to his theory of the origin of the Echinoderma by the continually increasing integration or centralisation of a radially-connected colony of worm-like persons. The phenomenon of self-division across the disc has been observed in species of Asteracanthion (Uraster) by Lütken and Kowalewsky; the production of comet-forms depends, however, on the separation of single arms, which then reproduce the whole disc and remaining arms by budding. Martens, in 1866, observed this in the case of a Luidia (Ophidiaster) in the Red Sea. Kowalewsky found that it was a common process with similar species and same locality. Sars observed it in Brisinga. Studer has described the regular occurrence in Labidiaster of a spontaneous casting off of the arms, but not the regeneration of disc and arms on the separated arms. Sir John Dalyell observed the whole process of reproduction of the disc on a single detached arm of *Asteracanthion* (*Uraster*) *glacialis*. The support which these facts lend to the "Astrocormus" theory is not of that value which Haeckel would assign to them, for such physiological tests of morphological doctrine are necessarily delusive. We have only to remember the facts as to cuttings and graftings in organisms generally in order to see that no special argument can be based upon them as to details of morphological composition. Haeckel proposes to divide the Echinoderms or Estrellæ as follows:—

Group I.—Protestrellæ: Class I. Asteriæ.
Group II.—Anthestrellæ: Class 2. Ophiuræ; Class 3. Crinoida.
Group III.—Thecestrellæ: Class 4. Blastoida; Class 5. Echinida; Class 6. Holothuriæ.

The second and third groups have developed from the first as diverging branches, whilst the Holothuriæ are modified descendants of Echinida. The resemblances between Gephyrea and Holothurians are declared by Haeckel to be entirely due to parallel adaptation (homoplasy), the pair of branched excretory organs of Bonellia, &c., being totally unrelated to the dendriform water-lungs of Holothurians, which are *five* in number in primitive forms and agree with branched inter-radial cœca (not the so-called "hepatic" cœca) of the intestine found in certain star-fishes (Archaster, Astropecten). E. R. L.

THE TRANSFORMATIONS OF BLISTER-BEETLES.—According to Dr. C. V. Riley, who has studied these creatures for some years, the young of all vesicants belonging to the Meloidæ, develop in the cells of honey-making bees, first devouring the egg of the bee and then the honey and bee-bread. They are all remarkable for their hypermetamorphosis, passing through several larval stages. The young Meloës are at first simple larvæ called triungulins, running actively about, climbing to flowers visited by bees, to which they attach themselves. They have stout thighs and claws, but feeble jaws. Only a few can get attached to the proper bees, the others must perish. Once in the cell the creature eats the bees' egg, and then moults and assumes the second larval condition. In this state it is clumsy and little locomotive, and feeds on the honey store. It then becomes a pseudo-pupa, and later a third larva within the partially-rent skin; the true pupa stage being still later. Another genus of the family is *Hornia*, of which a remarkable species is found around St. Louis, with the elytra and wings extremely reduced. The Hornia resides mostly in the galleries of *Anthrophora sponsa*, out of which it can scarcely crawl. The hypermetamorphosis is of the same character as in Meloë (*American Naturalist*, April). The genus Epicauta exhibits a very parallel history.

CURIOUS SOCIAL RELATIONS.—Stories about prairie dogs, owls, and rattlesnakes are well known, but trustworthy scientific observations about them are not very numerous. Mr. S. W. Williston (*American Naturalist*, April) gives the results of several years personal observations. He says that prairie dogs can thrive even in the dry scorched deserts of Southern Colorado, and the cold bleak Laramie plains. They are very provident in summer for winter, but yet emerge in spring much reduced in plumpness. At the approach of danger signals of distress are given, and when actually attacked they get into their mounds with wonderful speed, escaping beyond reach even when a rifle has scattered the brains of the animal. The burrowing owl not unfrequently occupies the same hole; the prairie dog pays little heed to it but tolerates it. The owls present a most ridiculous appearance, standing during the day at the entrance of their dwellings, in an attitude of the deepest contemplation; at the appearance of an intruder they begin the most comical bowings and curtsies, and at last with a cry like a watchman's rattle fly off to a neighbouring mound. The rattlesnakes cannot be said to be friendly with either of these creatures. Out of many hundreds of rattlesnakes destroyed by Mr. Williston, a number had devoured the young of the prairie dog, but none the young owl. The occupancy of a burrow by a